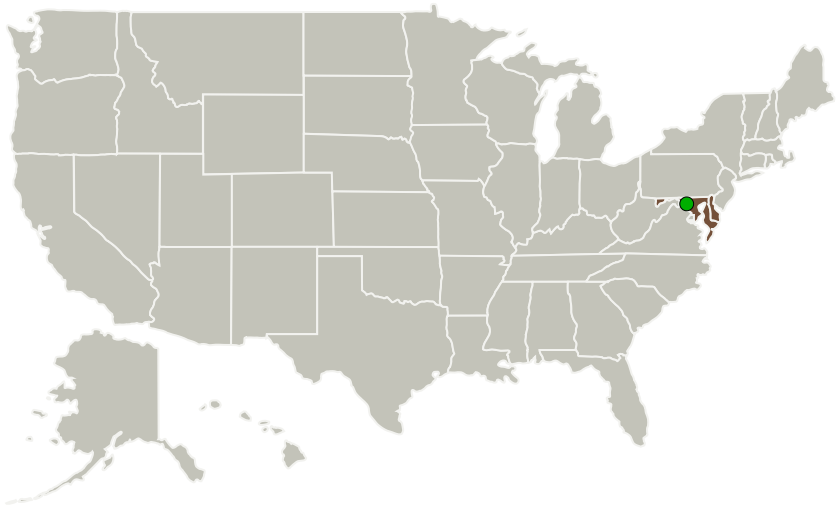
Linear Algebra Libraries for Massive GPU Clusters, Phase I

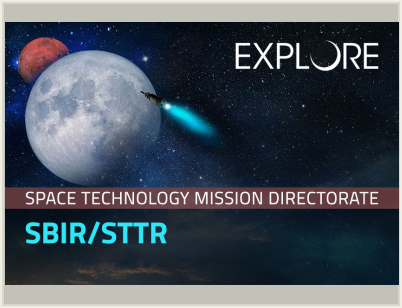
Completed Technology Project (2011 - 2011)

Project Introduction

In an attempt to build more computationally powerful systems and improve the FLOPS/dollar and FLOPS/Watt of high-performance computers (HPCs), we have recently seen the proliferation of GPU-based clusters. Many major vendors are now supporting this technology and such systems are becoming increasingly common everywhere from university research labs to the Top500 supercomputer list. To take advantage of these systems, however, requires understanding a new programming paradigm, namely the ability to program GPUs. In this project, we propose the development of tools to make programming massive GPU clusters transparent to the developer, thus allowing them to access their extreme computational power without significant additional effort. Specifically, we propose the development of dense and sparse linear algebra libraries that are optimized for the underlying GPU hardware but are called by the user from a standard, high-level interface. This work will build off our NASA-funded and commercially-successful CULA libraries, a set of GPU-accelerated, dense linear algebra libraries that run on single GPUs. More recently we have begun adding sparse linear algebra libraries to this package and prototyping their transition to multiple GPUs located in a single node. The proposed effort will involve scaling this technology so it is available on massive GPU clusters, thus making the power of such systems easily accessible to all programmers.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
EM Photonics, Inc.	Lead Organization	Industry	Newark, Delaware
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Delaware	Maryland

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138680)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

EM Photonics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

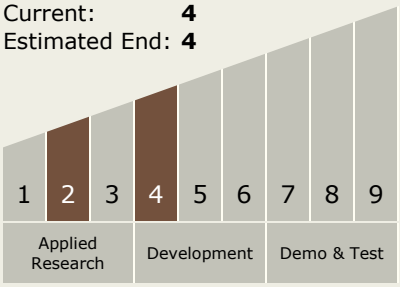
Carlos Torrez

Principal Investigator:

John R Humphrey

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.2 Mission Infrastructure, Sustainability, and Supportability
    - TX07.2.3 Surface Construction and Assembly

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System